

Application No.: 09/847901

Docket No.: SIW-008RCE

REMARKS

The foregoing amendment amends claim 1 and adds new claims 6-7. Pending in the application are claims 1, 2 and 4-7, of which claims 1, 6 and 7 are independent. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Claim 1 is amended to specify that the recited seal prevents flowing of a reaction gas from the ends of the first gas diffusion layer and the second gas diffusion layer. Support for the amendment can be found throughout the application as originally filed, at least for example, on page 1, first paragraph, on page 5, first paragraph and on page 15, third full paragraph.

Claim 6 is a new independent claim directed to the subject matter of claim 5, rewritten in independent form.

Claim 7 is a new independent claim directed to the subject matter of claim 2, rewritten in independent form, and further specifying that the liquid sealant is disposed on and in contact with both sides of the projecting portion, as shown in Figure 6 and described in the specification on page 6, last paragraph continuing onto page 7, page 9, last paragraph continuing onto page 10. *No new matter is added.*

Amendment and/or cancellation of the claims are not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and were done solely to expedite prosecution of the application. Applicants reserve the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

Interview with the Examiner on May 17, 2005

Applicants thank the Examiner for the courtesy of the telephonic interview with Applicants representatives on May 17, 2005. During that interview, the amendment to claim 1 and the subject matter of new claims 6 and 7 were discussed. The Examiner indicated that the amendment to claim 1 would overcome the outstanding rejection, and that claims 6 and 7 are patentable over the cited prior art references.

Application No.: 09/847901

Docket No.: SIW-008RCE

Claim 1 now specifies that the seal prevents flowing of a reaction gas from the ends of the first gas diffusion layer and the second gas diffusion layer. Even if the gaskets 304, 304' in the Jones reference can be considered a seal formed of a liquid sealant that hardens while in contact with gas diffusion layers, as set forth in claim 1, the gaskets 304, 304' in Jones are only disposed about the peripheral holes 210, shown in Figure 2, and do not seal the peripheral edges of the gas diffusion layers to prevent the flow of reaction gas from the ends, as recited in amended claim 1 (see column 6, lines 34-43 of Jones '933).

The amendment has ample support throughout the application as originally filed. For example, the specification, at least on the first paragraph of page 1, the first paragraph of page 5, and the third paragraph of page 15 recite that the seal prevents leaking of the reaction gas from the end faces of the diffusion layer and flowing around the periphery of the membrane electrode assembly of the fuel cell. Figures 1-6 also show that claimed seal seals around the ends of gas diffusion layers to prevent flowing of reaction gas along the periphery of the membrane electrode assembly.

New independent claim 6, which is a combination of claim 1 and claim 5 as also discussed. As recognized by the Examiner, the cited references, even in combination, do not disclose a seal formed of liquid sealant disposed in a groove of a separator that contacts an end face of a gas diffusion layer. The JP '169 reference does not disclose that a seal in a groove can contact a gas diffusion layer, nor does the Jones reference disclose that a seal can be provided in a groove, and there would be no motivation to modify either reference to include the subject matter set forth in claim 6.

In addition, the patentability of new independent claim 7 was discussed. New claim 7 is directed to the subject matter of claim 2, with the additional recitation that the liquid sealant is disposed on both sides of and in contact with a projecting portion extending about the periphery of the membrane electrode assembly. Figures 6 and 7 of the present application illustrate an example of the claimed subject matter set forth in claim 7. As shown, a projecting portion 18a is sandwiched between sealing material S, which also contacts the diffusion layers in the membrane electrode assembly 12. The Examiner also agreed that claim 7 distinguishes patentably over the cited prior art, because the gaskets 304, 304' in the Jones reference do not

Application No.: 09/847901

Docket No.: SIW-008RCE

seal about the periphery of the reaction region of the fuel cell, but rather only the peripheral holes 210, and do not sandwich a projecting portion of a membrane electrode assembly.

Further, proposed claims directed to a method of manufacture, which would recite the step of applying a liquid sealant to at least one surface of a separator during manufacture of the fuel cell, were discussed. The Examiner indicated that a new search would be required in order to determine the patentability of the method of manufacture claims, but that such claims would appear to distinguish over the prior art currently of record. Because a new search would be required, the Examiner indicated that such method claims should be pursued in a continuation patent application.

Claim Rejections under 35 USC § 102

Claims 1, 2 and 4 are rejected under 35 U.S.C. 102(b) as being anticipated by Jones 6,007,933. Applicants respectfully submit that the pending claims 1, 2, and 4, are patentable over the cited Jones reference, and request that the rejection be reconsidered and withdrawn.

The Jones reference does not teach or suggest a fuel cell including a liquid sealant that hardens while in close contact with both end faces of first and second gas diffusion layers of the fuel cell to provide a seal, as recited in claim 1. The Jones reference also does not teach or suggest a seal that contacts both end faces of the first gas diffusion layer and the second gas diffusion layer to prevent flowing of a reaction gas from the ends of the first gas diffusion layer and the second gas diffusion layer, as set forth in amended claim 1.

The Jones reference discloses a fuel cell assembly including gaskets 304, 304' for sealing around the peripheral holes 210 of the flow plates 200, as set forth in column 6, lines 33-43. The gaskets do not, and are not capable of, prevent reaction gas from flowing from the ends of the diffusion layers. The gaskets are not located in the reaction region to prevent gas leakage from the ends of diffusion layers and therefore do not anticipate the claimed invention.

Application No.: 09/847901

Docket No.: SIW-008RCE

According to the Examiner, the recitation in the claims of "a seal, provided onto the separators, which was liquid sealant at the time of application" is interpreted as "a solid seal per se, because such limitation refers to the initial state of the liquid sealant at the time of application, but the final state (the working seal) of the seal is solid as the liquid sealant hardens into solid sealant...".

However, the claimed seal is different from the solid gasket described in Jones for several reasons. Applicants respectfully note that an initially solid seal, such as the gasket of Jones, has dimensions and a shape that are determined before assembly of a membrane electrode assembly associated with the solid seal. Because the size and configuration of the seal is set *prior to* assembly, it is difficult to prepare a solid seal having accurate dimensions that is sized and configured to *precisely* fit to both ends of the first and second gas diffusion layers.

In contrast, the use of a seal formed of a liquid sealant that is liquid at the time of application allows for the resulting seal to have a size and shape that precisely matches the region of the fuel cell in which the seal is located. During formation of the seal, the liquid sealant to come into close contact with the membrane electrode assembly and hardens according to the size of the membrane electrode assembly, i.e., in compliance with the dimensions of the ends of the gas diffusion layers. While the gasket of Jones has a size, shape and configuration that are fixed during manufacture of the gasket, the claimed seal has a size, shape and configuration that can adjust according to the size, shape and configuration of the membrane electrode assembly being sealed. Thus, the seal of the present invention, which is liquid sealant at the time of application, has an advantage over a solid seal in that a precise dimension control, as required with a solid seal, can be dispensed with during manufacture of the seal. In addition, a close contact of the seal with the end faces of the gas diffusion layers can be accurately attained.

In particular, with a thin membrane electrode assembly in which electrolyte membranes and gas diffusion layers have a thickness on the order of a few hundred microns, it is extremely difficult to manufacture in advance a solid seal with precise dimensions and maintain a predetermined performance of the seal. An unevenness or error in thicknesses of the solid seals and in the positions of the end faces of the solid seals and the gas diffusion layers causes a deterioration in the sealing performance.

Application No.: 09/847901

Docket No.: SIW-008RCE

In contrast, the claimed seal, which is liquid sealant at the time of application, hardens *in compliance with* the thickness of the electrolyte membranes and the diffusion membrane, thus solving the problems that occur with solid seals that are not formed of a liquid sealant that is subsequently hardened while contacting gas diffusion layers of a fuel cell.

The JP 08-148169, also cited by the Examiner in the Office Action, does not compensate for the deficiencies of the Jones reference, because the JP '169 reference describes a fuel cell including a permanently solid O-ring gasket 15.

Claim Rejections under 35 USC § 103

Claim 5 is rejected under 35 U.S.C. 103(a) as being anticipated by Jones 6,007,933 as applied to claim 1 above, and further in view of Japanese publication JP 08-148169. As described above, independent claim 1, from which claim 5 depends, is patentable over the cited references. Therefore, claim 5, which includes all of the limitations of claim 1, is also patentable over the cited references.

New Claims

New claims 6 and 7 have been added to recite the subject matter of dependent claims 5 and 2, respectively, in independent form.

Claim 6 is patentable, because the cited references, alone or in combination do not disclose that a seal in a fuel cell can comprise a liquid sealant disposed in a groove on a separator and in contact with an end of a gas diffusion layers. The use of grooves facilitates application of the liquid sealant to the separator, and the grooves provide a guide for applying liquid sealant. In contrast, the JP '169 reference illustrates a solid o-ring that is separated from gas diffusion layers when disposed in a groove. The JP '169 reference could not be easily modified, because the position of the seal in precludes contact with the gas diffusion layers. In addition, the Jones reference requires the gaskets 304, 304' to interface with a flat surface on the plate 204, precluding use of a groove on a separator surface for receiving liquid sealant that hardens to form a seal.

Application No.: 09/847901

Docket No.: SIW-008RCE

Claim 7 is also patentable, because the cited references, alone or in combination, fail to disclose a fuel cell including seal that contacts end faces of gas diffusion layers as well as either side of a projecting portion extending from a solid polymer electrolyte membrane and projecting from the peripheries of an anode side diffusion electrode and a cathode side diffusion electrode, as recited in claim 7.

In summary, because the cited references do not teach or suggest a fuel cell including a component provided on the separators that forms a seal sealing a periphery of the fuel cell and/or a seal disposed in grooves on a separator while in contact with gas diffusion layer ends, claims 1, 2 and 4-7 are patentable.

Application No.: 09/847901

Docket No.: SIW-008RCE

CONCLUSION

In view of the above amendment, applicants believe the pending application is in condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue. If, however, the Examiner considers that obstacles to allowance of these claims persist, we invite a telephone call to Applicant's representative.

An appropriate Petition for Extension of Time is being filed concurrently herewith. If a any additional fees are due, please charge our Deposit Account No. 12-0080, under Order No. SIW-008RCE from which the undersigned is authorized to draw.

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Respectfully submitted,

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